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PROGRAM AND ABSTRACTS OF THE THIRTEENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF PARASITOLOGISTS

INDIANAPOLIS, INDIANA

DECEMBER 28, 29 and 30, 1937

PROGRAM[1]

TUESDAY MORNING SESSION, DECEMBER 28, 10:00 A. M.; ROOM 35, INDIANA MEDICAL SCHOOL.

Read

1. Experimental Transmissions of *Toxoplasma* in Canaries. (10 min.) (Lantern.) Fruma Wolfson, Johns Hopkins University.

2. Paper withdrawn.

3. Oöcyst Counts for Young Rats on a Basal Diet Supplemented with Various Feeding Stuffs and Experimentally Infected with *Eimeria nieschulzi.* (10 min.) (Lantern.) Elery R. Becker, Iowa State College.

4. Occurrence of Malaria in Young and Adult Red-Wing Blackbirds (*Agelaius p. phoeniceus*). (15 min.) Carlton M. Herman, Austin Ornithological Research Station and Johns Hopkins University.

5. The Influence of the Host's Rest Period on the Periodic Asexual Reproductive Activity of Avian Plasmodia. (15 min.) (Lantern.) Leslie A. Stauber, University of Chicago.

6. Further Studies on *Trichomonas columbae.* (10 min.) (Lantern.) Robert M. Stabler, University of Pennsylvania.

7. Observations on Venereal Trichomoniasis in Bovines. (15 min.) (Charts.) Charles W. Rees, U. S. Bureau of Animal Industry.

8. Binary Fission in *Dientamoeba fragilis.* (15 min.) (Lantern.) D. H. Wenrich, University of Pennsylvania.

9. The Pathogenicity of a Strain of Small Race *Endamoeba histolytica.* (15 min.) (Lantern.) William W. Frye and Henry E. Meleney, Vanderbilt University School of Medicine.

By Title

10. A Survey of Intestinal Protozoa among Children and Adults in Los Angeles. John F. Kessel and D. Sinitsin, Los Angeles County Hospital and the School of Medicine, University of Southern California.

11. A Strain of *Plasmodium relictum* from Doves and Pigeons. G. Robert Coatney, State Teachers' College, Peru, Neb.

12. The Effects of Phenylhydrazine on Avian Infections with *Plasmodium cathemerium.* Robert Hegner and Redginal Hewitt, Johns Hopkins University.

13. Susceptibility of Young Red Cells in Canaries to Malarial Parasites.

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[1] An alphabetical author index will be found at the end of the program.

Robert Hegner and Redginal Hewitt, Johns Hopkins University.

14. Transmission Experiments with *Plasmodium circumflexum* and *P. cathemerium* by Mosquitoes. Carlton M. Herman, Austin Ornithological Research Station and Johns Hopkins University.

15. Cross-Infection Experiments with Three Species of Amoebae from Reptiles. Quentin M. Geiman, Harvard Medical School and School of Public Health.

16. Experimental Infection of Mice with *Balantidium coli.* E. Clifford Nelson, University of Maine.

17. A Synopsis of the Flagellate Genus *Cochlosoma* Kotlán, with the Description of Two New Species. Bernard V. Travis, Iowa State College.

TUESDAY AFTERNOON SESSION, DECEMBER 28, 2:00 P. M.; ROOM 35, INDIANA MEDICAL SCHOOL.

Read

18. The Nature and Mechanism of Local Immunity in Parasitic Infections. (10 min.) Asa C. Chandler, Rice Institute.

19. Age Resistance of Chickens to the Cestode *Raillietina cesticillus* (Molin). (10 min.) (Lantern.) J. E. Ackert and W. M. Reid, Kansas State College.

20. The Resistance of the Herring Gull, *Larus argentatus,* to Experimental Infections of the Trematode, *Parorchis acanthus.* (15 min.) (Lantern.) Raymond M. Cable, Purdue University and the Marine Biological Laboratory.

21. Acquired Resistance in Sheep to Superinfection with a Nematode, *Cooperia curticei.* (15 min.) (Lantern.) John S. Andrews, U. S. Bureau of Animal Industry.

22. Resistance of Rats and Mice to Infection with *Capillaria hepatica.* (15 min.) (Lantern.) George W. Luttermoser, U. S. Bureau of Animal Industry.

23. Passive Immunity in Experimental Trichiniasis. (10 min.) (Lantern.) James T. Culbertson and Samuel S. Kaplan, College of Physicians and Surgeons, Columbia University.

24. The Immunity to the Hookworm, *Ancylostoma caninum,* Acquired by Dogs as a Result of Previous Infection. (15 min.) (Lantern.) G. F. Otto, K. B. Kerr and J. W. Landsberg, Johns Hopkins University.

25. The *in Vitro* Action of Immune Rat Serum on *Nippostrongylus muris* (Nematoda). (15 min.) (Lantern.) Merritt P. Sarles, University of Chicago.

26. Cellular Reactions during Immunity to *Nippostrongylus muris* in the Rat. (15 min.) (Lantern.) W. H. Taliaferro and M. P. Sarles, University of Chicago.

By Title

27. Immunological Studies with *Dirofilaria immitis.* John G. Arnold, Jr., and Timothy L. Duggan, Loyola University, New Orleans.

28. Resistance and Immunity Reactions in Infections with *Sparganum mansonoides.* Justus F. Mueller and Orren D. Chapman, College of Medicine, Syracuse University.

29. Dermal and Intradermal Skin Reactions in Oxyuriasis. Willard H. Wright and John Bozicevich, National Institute of Health, U. S. Public Health Service.

WEDNESDAY MORNING SESSION, DECEMBER 29, 10:00 A. M.; ROOM 35, INDIANA MEDICAL SCHOOL

Read

30. A Parasitological Reconnaissance in Alaska with Particular Reference to Varying Hares. (15 min.) Cornelius B. Philip, Rocky Mountain Laboratory, U. S. Public Health Service.

31. Status of the Generic Name *Profilicollis* of A. Meyer. (5 min.) Harley J. Van Cleave, University of Illinois.

32. The Life Cycle of a Trematode of Frogs. (5 min.) (Also by demonstration.) W. Henry Leigh, University of Illinois. (Introduced by Harley J. Van Cleave.)

33. A New Strigeid Cercaria which Produces a Bloat Disease in Tadpoles. (15 min.) (Lantern.) W. W. Cort and Sterling Brackett, Johns Hopkins University and University of Wisconsin.

34. Experimental Studies on Trematodes Belonging to the Subfamily Reniferinae. (10 min.) (Lantern.) J. Henry Walker, University of Alabama.

35. Life Cycle of a Fluke *Halipegus eccentricus* n. sp., Found in the Ears of Frogs. (10 min.) (Lantern.) (Also by demonstration.) Lyell J. Thomas, University of Illinois.

WEDNESDAY MORNING, DECEMBER 29, 11:30 A. M.; ROOM 35, INDIANA MEDICAL SCHOOL.

Presidential Address

36. Life History Studies and Their Relation to Problems in Taxonomy of Digenetic Trematodes. George R. La Rue, University of Michigan.

WEDNESDAY NOON, DECEMBER 29.

12:30 PARASITOLOGISTS' LUNCHEON, for members and guests.
1:30 ANNUAL BUSINESS MEETING.

WEDNESDAY AFTERNOON SESSION, DECEMBER 29, 3:00 P. M.; INDIANA MEDICAL SCHOOL (LABORATORY).

By Demonstration

32. The Life Cycle of a Trematode of Frogs. (Also read.) W. Henry Leigh, University of Illinois. (Introduced by Harley J. Van Cleave.)

35. Life Cycle of a Fluke *Halipegus eccentricus* n. sp., Found in the Ears of Frogs. (Also read.) Lyell J. Thomas, University of Illinois.

37. Some Useful Paraphernalia in Parasitological Entomology. Cornelius B. Philip, Rocky Mountain Laboratory, U. S. Public Health Service.

38. Studies on Agricultural Sanitation in North China. Gerald F. Winfield, Cheeloo University, Tsinan, Shantung, China.

39. Some Effects of Invasion by Myxosporidia on Certain Canadian Fishes. H. B. Fantham and Annie Porter, McGill University.

40. Microgamete Formation of *Haemoproteus beckeri* in the Blood of the Brown Thrasher (*Toxostoma rufum*). Robert L. Roudabush, Iowa State College.

41. Modifications of the Acetabulum in Trematodes. H. W. Manter, University of Nebraska.

42. Further Studies on Prosthogonimiasis. Ralph W. Macy, College of St. Thomas, St. Paul, Minn.

43. Cystocercous Cercariae of the Mirabilis Group from Lake Erie Snails. E. Eugene Dickerman, Bowling Green State University.

44. Some Cystocercous Cercariae from Alabama and Florida. Septima Smith, University of Alabama.

45. Giant Trematodes from the Wahoo, *Acanthocybium solandri*. Ross F. Nigrelli and Horace W. Stunkard, New York Aquarium and New York University.

46. Studies on the Life History of *Neoechinorhynchus cylindratus* (Van Cleave, 1913). Helen L. Ward, Purdue University. (Introduced by R. M. Cable.)

47. Studies on Oxyuriasis. XII. Epidemiological Findings in Washington, D. C. Eloise B. Cram and Lucy Reardon, National Institute of Health, U. S. Public Health Service.

48. The Larval Production of *Trichinella spiralis* in Rats Given Graduated Numbers of Larvae. L. O. Nolf and J. M. Edney, University of Iowa.

49. Studies on Forced Calcification in Experimental Trichina Infections. (Also read.) Theodor von Brand, G. F. Otto and Evelyn Abrams, Johns Hopkins University.

THURSDAY MORNING SESSION, DECEMBER 30, 10:00 A. M.; ROOM 35, INDIANA MEDICAL SCHOOL.

Read

50. Studies on the Oral Transfer of *Sparganum mansonoides* and on the Nature of *Sparganum proliferum*. (15 min.) (Lantern.) Justus F. Mueller, New York State College of Forestry.

51. Rates of Acquisition by Grazing Sheep of *M. expansa* and What They Reveal of the Available Pasture Infestation. (15 min.) (Lantern.) Norman R. Stoll, Rockefeller Institute, Princeton, N. J.

52. The Life Cycle of Anoplocephaline Cestodes. (15 min.) (Lantern.) Horace W. Stunkard, New York University.

53. Studies on the Bionomics and Seasonal Incidence of *Trichostrongylus axei* (Cobbold). (15 min.) (Lantern.) M. A. Stewart and J. R. Douglas, University of California.

54. Studies on the Course of Trichostrongyle Infestation in Sheep. (15 min.) (Lantern.) H. S. Cameron and M. A. Stewart, University of California.

55. Some Observations on the Epidemiology of the Dog Heart Worm (*Dirofilaria immitis*). (10 min.) Harold W. Brown, University of North Carolina.

56. Seasonal Changes in the Frequency with which Single *Strongyloides ratti* Produce Progeny of Indirect Development. (15 min.) (Lantern.) George L. Graham, Rockefeller Institute, Princeton, N. J.

57. Infection of Guinea-Pigs with *Strongyloides ratti*. (10 min.) A. J. Sheldon and G. F. Otto, Johns Hopkins University.

By Title

58. The Development of *Zygocotyle* from *Cercaria poconensis* Willey, 1930. Charles H. Willey, New York University.

59. Some Monogenetic Trematodes from the Galapagos Islands and the Neighboring Pacific. Frank G. Meserve, Macalester College, St. Paul, Minn.

THURSDAY AFTERNOON SESSION, DECEMBER 30, 2:00 P. M.; ROOM 35, INDIANA MEDICAL SCHOOL.

Read

60. Studies on Oxyuriasis. XIII. Problems Presented by a Family of Seven, All Infested with Pinworms. (15 min.) Myrna F. Jones, Eloise B. Cram and Willard H. Wright, National Institute of Health, U. S. Public Health Service.

61. Further Studies on the Life Cycle of *Contracaecum spiculigerum*. (5 min.) (Lantern.) Lyell J. Thomas, University of Illinois.

62. Life Cycle of *Raphidascaris canadensis* Smedley, 1933. A Nematode from the Pike, *Esox lucius*.. (10 min.) (Lantern.) Lyell J. Thomas, University of Illinois.

63. Physiological Observations on a Larval *Eustrongylides*. (15 min.) (Lantern.) Theodor von Brand, Barat College, Lake Forest, Illinois.

49. Studies on Forced Calcification in Experimental Trichina Infections. (15 min.) (Lantern.) (Also by demonstration.) Theodor von Brand, G. F. Otto and Evelyn Abrams, Johns Hopkins University.

64. Studies on Host Reactions to Larval Parasites. III. An Histolytic Ferment from the Cercariae of *Cryptocotyle lingua* (Creplin). (15 min.) (Lantern.) George W. Hunter, III, and Wanda S. Hunter, Wesleyan University.

By Title

65. *Trichinella spiralis* and *Leptospira icterohemorrhagiae* in the Hawaiian Islands. Joseph E. Alicata, University of Hawaii.

66. Studies on the Development of the Pigeon Capillarid, *Capillaria columbae*. Everett E. Wehr, U. S. Bureau of Animal Industry.

67. The Occurrence of *Trichostrongylus axei* (Cobbold) in Equines of Panama. A. O. Foster, Gorgas Memorial Laboratory, Panama.

68. On the Production and Migration of the Larva of *Trichinella spiralis*. L. O. Nolf and J. D. Crum, University of Iowa.

69. The Transplantation of Gravid *Trichinella spiralis*. L. O. Nolf, University of Iowa.

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ABSTRACTS

1. *Experimental Transmission of* Toxoplasma *in Canaries.* FRUMA WOLFSON, Johns Hopkins University.

An infection of *Toxoplasma* was discovered in May, 1937, in a canary which was kept in the laboratory for about 2 weeks, and was injected with sporozoites of *Plasmodium cathemerium* 11 days previous to its death. Various stages of *Toxoplasma* were observed in the circulating blood and in the internal organs, including the liver, spleen, lungs, kidneys, and bone marrow. The infection was transmitted to 13 canaries, to 5 from the original bird, and to the other 8 by a series of five subinoculations. Successful transfers were accomplished by intramuscular, intraperitoneal or intravenous injection of blood, bone marrow or brain tissue taken from dead birds. In nine cases the injections were performed within one hour after the death of the bird; in the other four cases they were done from 12 to about 24 hours after death. One attempt to use the material from a bird dead more than 24 hours proved unsuccessful. The diagnosis of infection with *Toxoplasma* was in two cases by the examination of blood films, and in all cases by the study of tissue preparations stained with Giemsa. In addition to *Toxoplasma*, the experimental canaries carried plasmodial infections. All canaries died from 5 to 14 days after being injected with *Toxoplasma.* Since malaria seldom kills canaries in such a short period, the death of the birds was evidently due to the *Toxoplasma.* Autopsies always showed a typical pathology. Birds injected at the same time usually died on the same day. Three control canaries kept in cages with the birds carrying *Toxoplasma,* showed no infection.

2. Paper withdrawn.

3. *Oöcyst Counts for Young Rats on a Basal Diet Supplemented with Various Feeding Stuffs and Experimentally Infected with* Eimeria nieschulzi. ELERY R. BECKER, Iowa State College.

Feeding stuffs having a protein content of 30 per cent or more were fed at the 10 per cent level, and those with less protein at the 30 per cent level. The control diet in all cases was the basal formula made up to 4 per cent with Fleischmann's powdered yeast. *W*-values represent the ratio of the weight gains made by the rats on the test diet to the same by those on the control diet during the first 16 days on the special diets. *F*-values represent the ratio of the number of oöcysts passed by the test series of rats to the same passed by the control series following experimental infection with *Eimeria nieschulzi* on the ninth and twelfth days following the date of the first experimental feedings. The *W*-values so far obtained are as follows: yellow corn-meal, 1.09; hulled oats, 1.25; ground oat hulls, 0.69; ground wheat, 1.63; linseed meal, 0.80; meat and bone meal, 0.11; ground barley, 0.92; ground rye, 1.5; wheat bran, 1.73; wheat flour middlings, 1.72; soy bean meal, 1.0. The *F*-values are as follows: yellow corn-meal, 0.47; hulled oats, 0.59; oat hulls, 0.49; whole wheat, 0.92; linseed meal, 0.94; meat and bone meal, 0.31; ground barley, 0.98; ground rye, 1.83; wheat bran, 1.91; wheat flour middlings, 2.65; soy bean meal, 0.51.

4. *Occurrence of Malaria in Young and Adult Red-wing Blackbirds* (Agelaius p. phoeniceus). CARLTON M. HERMAN, Austin Ornithological Research Station and Johns Hopkins University.

The prevalence of *Plasmodium* was determined by subinoculating blood from red-wing blackbirds (*Agelaius p. phoeniceus*) into malaria-free canaries. Approximately 60 per cent of the red-wings were found to harbor malaria parasites which were diagnosed in the canaries. Two species of *Plasmodium* were observed: *P. circumflexum* and *P. cathemerium.* No mixed infections were discovered. Of 45 red-wing nestlings, 26 were subsequently recaptured in traps at various intervals after leaving their nests. Blood obtained from 3 of these birds was injected into malaria-free canaries at 3 successive recaptures at intervals of

not less than one week. Blood obtained from 8 young red-wings was inoculated into canaries at 2 successive recaptures and from the remaining 15 only at one recapture. A greater number of young birds obtained their infections after leaving the nest that while they were still nestlings. The prevalence of malaria in the adult red-wings was higher than the incidence in the young birds.

5. *The Influence of the Host's Rest Period on the Periodic Asexual Reproductive Activity of Avian Plasmodia.* LESLIE A. STAUBER, University of Chicago.

Separate experiments using *Plasmodium cathemerium, P. relictum* var. *matutinum* (Huff) and a single parasite strain from *P. cathemerium* were performed. In compartments of a light-tight cabinet canaries were exposed to alternate 12-hour periods of differing illumination intensity. Three groups were used: (a) 105 ft. candles of illumination during one 12-hour period contrasted with 1.4 ft. candles the following period; (b) 41.5 versus 4.6 ft. candles and (c) 20 versus 7.3 ft. candles. Each compartment also contained subgroups of which some birds were allowed food only during the period of higher intensity and some only during the period of lower intensity illumination. Controls received 12 hours of darkness and 12 hours of light (7.3 ft. candles) plus food. After adaptation the birds were injected with parasites. The birds' periods of sleep were noted. The percentage of segmenting parasites in 200 asexual parasites per stained blood smear (made approximately every two hours) was computed. When the intensity differed greatly between the two periods (Groups *a* and *b*) the parasites exhibited synchronous segmentation which showed the same relationship to the period of lower illumination intensity (sleep) as those of the controls to darkness, regardless of time of feeding. In Group *c* (light conditions more nearly equal) the time of segmentation was more variable but chiefly related to the period when food was absent (sleep) regardless of illumination intensity. The parasite's periodic asexual reproductive activity, therefore, seems to be related to the host's rest period.

6. *Further Studies on* Trichomonas columbae. ROBERT M. STABLER, University of Pennsylvania.

Continuing the study of *Trichomonas columbae* infections in birds, the author examined over one hundred domestic pigeons from thirteen different sources, twenty-eight raptorial birds (twenty-six hawks and two owls) and fifty-nine other birds (*i.e.,* robins, swallows, etc.) from four different orders and nine families. All birds except the raptores and pigeons have been negative for *T. columbae.* The pigeons showed an 82.4 per cent infection, with only one source (two birds) presenting all negative hosts. Of the raptorial birds, eighteen hawks and two owls have been free from infection. Five hawks have died showing enormous numbers of *T. columbae,* two of which had extensive concomitant bacterial infections, the other three showing none. Four hawks positive for the flagellate have remained alive and apparently healthy. Two of these were infected experimentally and two were young peregrine falcons which were found to be positive on removal from the nest. These latter two had, through their feeding habits, been infected from pigeons, as the American peregrine preys to a large extent upon these birds. As additions to the morphology of *T. columbae,* the author has seen a parabasal body as well as a parabasal fibril and has noted that the edge of the undulating membrane in non-dividing forms frequently bears a double marginal filament, as is the case in certain other species of *Trichomonas.*

7. *Observations on Venereal Trichomoniasis in Bovines.* CHAS. W. REES, U. S. Bureau of Animal Industry.

In August, 1936, 4 virgin heifers, free from infection with *Brucella abortus,* were inoculated intravaginally with a bacteria-free strain of *Trichomonas foetus* which had been maintained *in vitro* with frequent transplantations for a considerable period. Two other heifers were kept as controls. The controls conceived as a result of the first service, and in June, 1937, each bore a healthy calf. Of

the four experimentally infected heifers, one was killed because she failed to show signs of estrum; the three remaining heifers showed the presence of *T. foetus* in the vagina for 60 to 90 days following inoculation; these infected heifers had irregular periods of estrum and at each period they were served by non-infected bulls. In March, 1937, only one heifer showed signs of pregnancy; in May, 1937, the other two heifers showed signs of pregnancy; at the present time, October 20, 1937, none has calved. A bull lightly infected with *T. foetus* was permitted to serve once each of three non-infected heifers. These three heifers became infected, the average incubation period being about 12 days. In a herd of approximately 300 dairy cattle, 7 out of 20 bulls examined were found to be infected with *T. foetus*. From September, 1936, to September 1937, 18 cases of infection were discovered in cows and heifers of this herd; several cows that had borne at one time or another normal calves were found to be infected. The calf crop of the infected cows averaged 0.1 calf per cow, as compared to a crop of 0.7 calves per cow for the rest of the herd. Recovered cows appeared to be immune, because when served by infected bulls they bore healthy calves.

8. *Binary Fission in* Dientamoeba fragilis. D. H. Wenrich, University of Pennsylvania.

Nuclear division is mitotic. In the prophase a spireme-like condition is followed by the formation of four short, longitudinally-split, rod-shaped chromosomes, one of which is shorter than the others and one of which is apparently derived from the differentiated granule designated as an "endosome" by the author in previous papers. During the prophase a laterally-placed division center or "centriole" elongates to form an intradesmose. The metaphase is followed by the separation of the daughter chromosomes from each other in the anaphase in a typically mitotic manner. The nuclear membrane seems to persist during division except when constricted into two parts in late anaphase. The post-division desmose connecting the two daughter nuclei persists for some time after nuclear division but eventually disappears. Division of the cell body may take place soon after nuclear division but is often delayed. Nuclear division in binucleate individuals is rare. Abnormalities in nuclear division sometimes occur, such as those which give rise to daughter nuclei of different sizes. Many nuclear conditions are found which do not seem to fit into the normal cycle and are considered to be abnormal.

9. *The Pathogenicity of a Strain of Small Race* Endamoeba histolytica. William W. Frye and Henry E. Meleney, Vanderbilt University School of Medicine.

A strain of "small race" *E. histolytica* with cysts measuring less than nine micra in diameter was isolated from a woman who was being treated for hypertrophic arthritis of the spine in the Out-Patient Service of the Vanderbilt University Hospital. One month before the stool examination was made she had had a slight diarrhea, following a period of constipation, and at that time she had noticed blood in her stool. There were no other symptoms referable to amoebic infection. The complement fixation reaction was positive before treatment with carbarsone and negative one month after treatment. The pathogenicity of this strain was studied in a series of twenty-two kittens, inoculated by ileum from cultures of the organism. The incidence of infection was low, 22.7 per cent, corresponding quite closely with our less virulent strains of large race *E. histolytica* studied previously. The lesions produced in kittens were on the average milder than those produced by any of our human large race strains. The lesions were all small shallow ulcers except in one kitten which showed two rather large deep ulcers. This indicates that the small race of *E. histolytica* has a certain degree of pathogenicity for kittens.

10. *A Survey of Intestinal Protozoa among Children and Adults in Los Angeles.* John F. Kessel and D. Sinitsin, Los Angeles County Hospital and the School of Medicine, University of Southern California.

With the exception of the reports of Johnstone *et al.* (1935) upon prisoners and Iverson and Johnstone (1937) upon food handlers in San Francisco, reports of the incidence of intestinal protozoa in California have been from hospital patients, from patients of private physicians or from individuals suspected of harboring intestinal protozoa. In the present study, children upon admission to the Los Angeles City Juvenile Detention Home, adult food handlers of the Los Angeles County Hospital and an adult group of clinic patients, having no gastro-intestinal complaints, were examined. In all, 2014 individuals were examined, 1338 in the adult group and 678 children. The percentage of positive cases in each group is listed below:

	Adults	*Children*	*Total*
Endamoeba histolytica	3.2	3.5	3.3
Endamoeba coli	16.3	22.0	18.3
Endolimax nana	11.4	11.0	11.0
Iodamoeba bütschlii	2.0	4.7	3.0
Dientamoeba fragilis	1.3	2.5	1.7
Giardia	2.8	8.8	4.8
Chilomastix	4.4	1.5	3.5
Trichomonas	2.0	2.2	1.5
Enteromonas	2.0	0.7	1.6

11. *A Strain of* Plasmodium relictum *from Doves and Pigeons.* G. Robert Coatney, State Teachers' College, Peru, Neb.

During the past summer an immature Mourning Dove was found harboring a light infection of *P. relictum.* The infection was transferred to other doves and to the canary. In all these birds the infection was a light one. When inoculations were made to the pigeon very heavy infections resulted which, in every instance, proved fatal. Later, a natural infection of the same species was found in a common pigeon. This strain when passed to doves and canaries also produced light transitory infections. In the pigeon the infections were heavy and decidedly pathogenic. Two birds, given plasmochin during the acute stage, recovered and now carry chronic infections. Infections have been maintained in the chick for 17 days, at this writing, by the "rapid passage" method.

12. *The Effects of Phenylhydrazine on Avian Infections with* Plasmodium cathemerium. Robert Hegner and Redginal Hewitt, Johns Hopkins University.

When phenylhydrazine hydrochloride was injected into clean canaries the proportion of young red cells to old red cells present in the peripheral blood increased from about 6 per cent to more than 90 per cent. In treated birds that were inoculated with *P. cathemerium,* the number of parasites reached a higher peak than in normal birds inoculated with the same species of malarial parasite at the same time and with the same strain and number of organisms. We conclude that the greater number of young red cells in the phenylhydrazine-treated birds enabled a larger proportion of the merozoites to find and infect red cells and to grow to maturity and segment.

13. *Susceptibility of Young Red Cells in Canaries to Malarial Parasites.* Robert Hegner and Redginal Hewitt, Johns Hopkins University.

Clean canaries were inoculated with *Plasmodium cathemerium.* When the infections became patent, blood smears were taken several hours after segmentation of the schizonts. It was found that from 76.3 to 88.4 per cent of the young trophozoites were present in young red cells although the ratio of young cells to old cells was about 6 to 94. Many of the infected young cells contained several parasites, the percentages being as follows: 6 per cent with 6 each, 3 per cent with 5, 15 per cent with 4, 30 per cent with 3, and 26 per cent with 2. All red

cells parasitized by 4 or more organisms were destroyed within 21 hours and only one red cell was noted containing 3 old parasites. The destruction of multiple-infected cells would account for most of the decrease in the number of parasites that is known to take place during an asexual generation.

14. *Transmission Experiments with* Plasmodium circumflexum *and* P. cathemerium *by Mosquitoes.* CARLTON M. HERMAN, Austin Ornithological Research Station and Johns Hopkins University.

Plasmodium circumflexum and *P. cathemerium* were obtained from red-wing blackbirds (*Agelaius p. phoeniceus*) and from cowbirds (*Molothrus a. ater*) on Cape Cod. Seven species of culicine mosquitoes were tested as possible vectors on canaries infected with the strains of malaria obtained from the red-wings; five species of mosquitoes were tested on the strains obtained from the cowbirds. *Theobaldia melaneura* successfully transmitted both strains of *P. circumflexum. Culex pipiens* and *Aedes sollicitans* were found to be capable of transmitting the two strains of *P. cathemerium* in canaries and *Culex pipiens* transmitted *P. cathemerium* from a cowbird to a canary.

15. *Cross-infection Experiments with Three Species of Amoebae from Reptiles.* QUENTIN M. GEIMAN, Harvard Medical School and School of Public Health.

Numerous species of Endamoebae, including one pathogenic species, have been described from reptiles. The availability of the pathogenic species, *Endamoeba invadens,* and of two other morphologically distinct species, *E. barreti* and *E. terrapinae,* and their successful cultivation in the same medium made the cross-infection experiments possible. The following inoculation experiments were performed: (a) 28 frogs (*Rana pipiens*) with *E. invadens*; (b) 2 snakes (*Natrix cyclopion*) with *E. terrapinae*; (c) 11 snakes (4 *Natrix sipedon,* 4 *N. cyclopion,* 2 *Coluber constrictor,* and 1 *Thamnophis sirtalis*) with *E. barreti*; (d) 8 turtles (4 *Chrysemys elegans,* 2 *C. picta,* and 2 *Chelydra serpentina*) with *E. invadens;* (e) 15 snakes of four species with cultures obtained from turtles after inoculation with *E. invadens.* The results indicate (a) that *E. invadens* is non-infective for frogs unless the rectum is ligated and even then it is non-pathogenic; (b) that *E. terrapinae* is non-pathogenic for snakes although infection was produced and maintained 35 days; (c) that *E. barreti* is non-pathogenic for snakes although infection was produced and maintained 31 and 41 days in two of the eleven inoculated; (d and e) that *E. invadens* is non-pathogenic for turtles of three species since amoeba were recovered from seven turtles 31 to 50 days after inoculation, four of the seven strains proving to be *E. invadens* by their morphology and pathogenicity for snakes, and three (2 *E. terrapinae* and 1 *E. barretti*) being morphologically identical with amoeba of the original hosts.

16. *Experimental Infection of Mice with* Balantidium coli. E. CLIFFORD NELSON, University of Maine.

In a series of experiments a total of 44 mice were inoculated intragastrically with *Balantidium coli* from the pig. Ten mice died at the time of injection or were killed immediately afterward. Four of these autopsied immediately showed that the injection had reached as far as 10 inches down the small intestine. Active balantidia were still present in the stomach and small intestine of mice autopsied at 25 minutes, 30 minutes, 7½ hours and 10 hours (3 mice) after death. The method of injection was shown to be effective and the organisms viable. Thirty-four of the mice were killed at intervals of from one hour to 48 hours after injection. Of these 28 were killed and examined 10 hours or longer after injection. All but five of the mice were found to have become negative. Balantidia were found in the cecum of one at 3 hours and in the stomach but nowhere else in four mice killed and examined at 7, 7½, 9½ and 12 hours after injection. Apparently in the mouse *Balantidium coli* is readily eliminated from the intestine. The survival of the organism in the stomach for as long as 12 hours without

apparent ill effects is surprising. It is generally assumed that trophozoites do not survive in the stomach thereby effectively preventing infection by means of trophozoites taken with food and water.

17. *A Synopsis of the Flagellate Genus* Cochlosoma *Kotlán, with the Description of Two New Species.* Bernard V. Travis, Iowa State College.

Cochlosoma rostratum Kimura is believed to be a synonym of *C. anatis* Kotlán for the following reasons: (1) European and North American domestic ducks have been derived of the same species of wild duck, (2) the small differences in size reported by the two authors is not sufficient evidence to separate the flagellates into two species, and (3) the differences in morphology are considered to be differences in interpretation of the structures. *C. anatis* was studied from four species of wild ducks, Mallard, *Anas platyrhynchos platyrhynchos* (L.), Shoveler, *Spatula clypeata* L., Pintail, *Dafila acuta tzitzihoa* (Vieillot), Lesser Scaup, *Nyroca affinis* (Eyton), and from the domesticated Mallard, *Anas platyrhynchos* L. One new species of *Cochlosoma, C. picae,* is described from the American Magpie, *Pica pica hudsonia* (Sabine). It differs from *C. anatis* chiefly in that it is smaller, and is without the cytoplasmic granules. A second new species is described from the Eastern Robin, *Turdus migratorius migratorius* Linn. This is named *C. turdi.* It differs from *C. anatis* in that it is smaller, and from *C. picae* in the presence of cytoplasmic granules and a larger sucker disc.

18. *The Nature and Mechanism of Local Immunity in Parasitic Infections.* Asa C. Chandler, Rice Institute.

Parasites located in the skin, in the lumen of the intestine, in the lumina of some ducts, and in the epithelial lining of intestine or ducts, are capable of producing a local instead of a general immunity, due to the fact that immunizing material derived from the parasites fails to reach the general circulation. Instead, it is either wasted directly into the lumina of the ducts or organs, or taken up by local epithelial cells. If these cells are killed by an excess of antigenic material taken up by them, the latter is not liberated into the general circulation but is eliminated outwardly. Under these circumstances there is no opportunity for a general distribution of the antigen and therefore no opportunity for general immunity to develop. This true local immunity is to be distinguished from a locally manifested general immunity. Examples are *Cordylobia* and *Cochliomyia* infections in the skin, some helminthic infections of the intestine and liver.

19. *Age Resistance of Chickens to the Cestode* Raillietina cesticillus (*Molin*). J. E. Ackert and W. M. Reid, Kansas State College.

The phenomenon of increasing resistance with age in the growing animal to intestinal nematodes has been recorded many times but information upon age resistance of animals to tapeworms is much more limited. In a series of experiments in which infective cysticercoids of *Raillietina cesticillus* were administered to growing chickens of different ages, results were obtained which demonstrated age resistance to this tapeworm. Fifteen chickens, 20 to 51 days of age parasitized with approximately 50 cysticercoids had an average of 4.87 tapeworms per bird; whereas 27 fowls, 71 to 150 days old had an average of 3.22 worms per bird, a difference of 1.65 tapeworms which was 5.07 times the probable error and therefore considered significant. Instead of length of tapeworms, the number of proglottids was used as the factor of comparison of size of cestodes. The 15 chickens, 20 to 51 days of age had an average of 94.91 proglottids as compared with an average of 79.3 proglottids for the 27 chickens of the older group. This difference of 15.61 proglottids was 4.19 times its probable error, also a significant difference. These results demonstrate that chickens (White Leghorns) approximately 2½ to 5 months of age may be markedly more resistant to the viability and growth of the cestode *Raillietina cesticillus* than are younger fowls (about 1 to 2 months of age) from the same flock.

20. *The Resistance of the Herring Gull,* Larus argentatus, *to Experimental Infections of the Trematode,* Parorchis acanthus. . RAYMOND M. CABLE, Purdue University and the Marine Biological Laboratory.

Parorchis acanthus (Nicoll, 1907) occurs only in the cloaca and bursa of the host, making it possible to remove all of the parasites by a simple operation and observe the results of repeated infections. Eight experimental and three control herring gull nestlings were used. Each of the experimental birds was fed a known number of metacercariae and the adult worms were removed after 23 days. Four days later, both experimental and control birds were fed a known number of metacercariae and, after 23 days, the adult parasites were removed. The worms recovered from each bird were examined for maturity and weighed to determine if stunting or inhibition of development had occurred. An analysis of the results obtained indicates that, under the conditions of the experiment, an initial infection of the herring gull with *P. acanthus* did not protect the host from a subsequent infection, at least not to the extent that a significant effect on either the number, weight, or degree of maturity of the parasites was noted. It was observed that certain birds were more resistant to infections than others. This variation in resistance was noted in both initial and subsequent infections and a bird which yielded a large number of parasites from the initial infection retained a relatively high degree of susceptibility throughout the experiment. An age resistance is suggested by the fact that a smaller number of worms were recovered from both the second experimental and control infections than from the initial experimental infections.

21. *Acquired Resistance in Sheep to Superinfection with a Nematode,* Cooperia curticei. JOHN S. ANDREWS, U. S. Bureau of Animal Industry.

The infective larvae of *C. curticei* in lambs previously uninfected with these parasites, migrated to the crypts of the intestinal mucosa where they passed through the third ecdysis on the fourth day after infection. While in the crypts the larvae increased in size, thereby producing increased pressure on the epithelium. This pressure appeared to be sufficient in some instances to produce destruction of the epithelial cells. The tissue destruction was frequently accompanied by small areas of inflammation. The larvae did not enter the submucosa, but returned as early fourth-stage larvae to the lumen of the intestine on the fifth day after infection. In lambs previously infected with this nematode, the administration of larvae produced an intense inflammatory reaction and resulted in the encapsulation of the worms. This reaction ultimately killed the larvae. The initial reaction was similar to that observed in any inflammatory process. The center of the area containing the larvae rapidly became an amorphous necrotic mass, surrounded by cells of lymphoid character. Some of the older lesions showed a slight tendency to encapsulation.

22. *Resistance of Rats and Mice to Infection with* Capillaria hepatica. GEORGE W. LUTTERMOSER, U. S. Bureau of Animal Industry.

In experimental infections, it was found that the white mouse and hooded rat differed markedly in their resistance to *Capillaria hepatica.* A natural resistance was indicated by the fact that in the majority of the 26 young rats, each of which was given 1,200 to 2,500 eggs, the worms which developed died before depositing eggs; however, in most of the young rats given either 500 or 5,000 infective eggs each, the worms matured and deposited eggs. The rats also showed a partial age resistance, since the older rats were able to tolerate a larger number of infective eggs and developed fewer liver lesions than did the younger rats. Using the liver picture as a quantitative index to the degree of infection, it was apparent that rats acquired a resistance to superinfection. Twenty-eight days after the primary infection the rats appeared highly refractory to superinfections, as shown by the small number of hepatic lesions resulting from the second infection. This acquired resistance was still apparent on the 56th day following the primary infection. The low intensity of the *C. hepatica* infections found in house rats in Baltimore (Luttermoser, 1936)

seemed to indicate that resistance of some kind was also operative under natural conditions. Mice, on the other hand, developed infections with *C. hepatica,* the worms reaching the egg-bearing stage in all cases. Furthermore, infected mice did not acquire a resistance to superimposed lethal doses, regardless of the size and duration of the first infection. However, the mice did show a partial age resistance to this infection as did the rats.

23. *Passive Immunity in Experimental Trichiniasis.* JAMES T. CULBERTSON AND SAMUEL S. KAPLAN, College of Physicians and Surgeons, Columbia University.

Mice are protected against *Trichinella spiralis* by injection with anti-*Trichinella* rabbit serum. A smaller percentage of passively immunized mice die and fewer larvae invade their muscles than among controls. The immune serum appears to act specifically against the ingested larvae maturing to adult worms in the intestine. Somewhat less than half as many larvae developed to adults in mice treated with immune serum (17.6 per cent) as in those given normal serum (36.0 per cent) and in untreated controls (37.1 per cent). The average total number of larvae recovered from the muscles of immunized mice was 13,221 compared with 20,964 from controls, and the average ratio of larvae recovered from the muscles per larva fed was 44.0 for the immunized mice and 69.9 for controls. The immune serum, therefore, fails to act upon the larvae in muscles since the average total counts of larvae in treated animals is not depressed below that value expected because of the inhibitory effect of serum upon the development of the adult worms. The immunity to trichiniasis represents a generalized response, the antibody being blood-borne, but this antibody exerts its action locally upon the ingested larvae developing to adults in the intestine. It is indicated that an immune serum could not be expected to provide significant aid in treating clinical trichiniasis, unless injected at about the same time the infected meat was ingested, and prior to symptoms.

24. *The Immunity to the Hookworm,* Ancylostoma caninum, *Acquired by Dogs as a Result of Previous Infection.* G. F. OTTO, K. B. KERR, AND J. W. LANDSBERG, Johns Hopkins University.

Young mongrel dogs were protected against overwhelming infections with hookworm, *Ancylostoma caninum,* by 25–30 immunizing infections gradually increasing from 15 to 120,000 larvae over a period of 4–5 months. Throughout this period the egg production and the host blood picture were followed quantitatively. About 3 weeks after the last immunizing infection these animals and previously uninfected litter mates were given test infections of 120,000 to 200,000 larvae. None of the 4 immunized animals showed any appreciable effects from the test infections. The 2 immunized animals in 1 litter, given test infections of 120,000 larvae, harbored only 118 and 203 hookworms when killed 3 weeks later, whereas the previously uninfected litter mate died on the 9th day and 13,400 hookworms were recovered from its intestine. The 2 immunized animals in another litter, given test infections of 200,000 larvae, were killed 35 days later and 52 and 56 hookworms recovered. In this case, the previously uninfected litter mate lost weight and became anemic (2,400,000 R.B.C. and 4.9 gm. hemoglobin). It was killed on the 35th day and 1,263 hookworms recovered. The immunity to hookworm infection seems to be essentially the same as that which has been demonstrated in other worm infections. Apparently, however, because of the debilitating effect of the blood sucking hookworms the immunizing infections must be given in slowly increasing doses over a long period of time. If the size of the initial infections increases rapidly the immunity is apparently "broken" before it is firmly established.

25. *The* in vitro *Action of Immune Rat Serum on* Nippostrongylus muris *(Nematoda).* MERRITT P. SARLES, University of Chicago.

Preparasitic infective larvae of *N. muris* were freed from bacteria adherent to the cuticula by treatment with a 0.1 per cent solution of mercuric chloride, and incubated at room temperature or 37° C. in small drops of fluid sealed by vaseline between

a sterile slide and coverslip. Tests were made with immune rat sera and controlled by placing worms in normal rat sera and in saline. The immune sera were from rats exposed to repeated infection, and of proven antibody content, as shown by their power to passively immunize normal rats. Parasitic worms in early phases of development in the lungs and intestine of rats were also tested. All three stages of the parasite survived longer and were more active in serum than in saline; they survived about equally well in unheated and inactivated normal and immune sera, and in both were seen actively feeding by vigorous, rhythmical contractions of the esophagus. Only infective larvae developed *in vitro,* passing through what corresponded to the parasitic phase of development in the skin. Evidences of antibody action, seen with worms in immune sera, but not in normal sera or saline, included: (a) decreased activity (of larvae and lung-stage); (b) inhibition of development (of larvae); and (c) formation of precipitates of 4 types: (1) cuticular (with larvae and lung-stage only), (2) excretory, (3) oral, and (4) intestinal. The correspondence of certain of these reactions with those seen in actively and passively immunized rats will be discussed.

26. *Cellular Reactions During Immunity to* Nippostrongylus muris *in the Rat.* W. H. Taliaferro and M. P. Sarles, University of Chicago.

Acquired immunity is to a large extent based upon the action of antibodies, with certain cells functioning during later stages in clearing up parasitic and other debris. In the skin of normal rats, the migrating larvae incite a mild temporary diffuse inflammation whereas in the skin of immune rats, the migrating larvae are temporarily delayed and immobilized (probably due to antibodies) and are surrounded by loose accumulations of cells (mainly eosinophils and hypertrophying agranulocytes of hematogenous origin) or if the immunity is intense many are killed during which a precipitate of antibody origin forms around the anterior end and the cellular accumulations in turn form nodules, become fibrotic and eventually clear up the debris. In the lungs, where similar differences are found in normal and in immune animals, the mononuclear cells concerned in forming the nodules arise largely from local septal cells. In the intestine of normal rats connective tissue mast cells, eosinophils and macrophages increase in number in the lamina propria only after 10 days whereas in the intestine of immune rats, these same cells become immediately more numerous. The worms are more quickly eliminated and their growth and egg production are inhibited (probably due to antibodies).

27. *Immunological Studies with* Dirofilaria immitis. John G. Arnold, Jr., and Timothy L. Duggan, Loyola University, New Orleans.

The present study was undertaken to determine whether any immunization could be effected in dogs against the heart worm, *Dirofilaria immitis.* Sterile, saline suspensions of the macerated parasites were injected weekly into rabbits for three consecutive weeks. Six weeks after the last injection microfilaria were subjected to the sensitized serum with marked lethal results. Standardization experiments are now being undertaken.

28. *Resistance and Immunity Reactions in Infections with* Sparganum mansonoides. Justus F. Mueller and Orren D. Chapman, College of Medicine, Syracuse University.

An antigen was prepared by digesting 1.75 grams of dried, powdered, ether extracted adult *D. mansonoides* in 80 cc. of 0.1% HCl in physiological saline solution at room temperature for 48 hours. This antigen was used for complement fixation tests on the blood serum of rhesus monkeys previously infected with *Sparganum mansonoides,* using human normal serum and monkey normal serum as controls. Complement fixation tests were performed in duplicate, one set being incubated at 37° C. for 30 minutes, the other at 4° C. for four hours. Dilutions of the above antigen of 1–5, 1–10, 1–20, 1–40 were used. Strong positive tests were obtained with the sera of experimental monkeys with antigen dilutions of 1–5 and 1–10 at

both temperatures. Less positive results were obtained with the weaker dilutions of antigen. Controls were in all cases negative. Reactions were more delicate at the lower temperature of incubation. Definitely positive results were obtained in monkeys which had as few as 2 spargana in the tissues. This method seems worthy of trial as an aid in the diagnosis of suspected cases of sparganosis in man. An antigen prepared by suspending 0.5 gram of powdered adult *D. mansonoides* in 100 cc. of distilled water was used in a series of graduated injections at three day intervals in an attempt to immunize monkeys to infection with spargana. After 9 injections graduated from 0.1 to 4.0 cc. the monkeys were infected by injection of procercoids and compared with similarly infected controls. On later examinations both experimental and control monkeys appeared equally infected. In the controls, however, the larvae were found mainly free in the tissues, whereas in the experimental animals many of the larvae were walled off in tough cysts, especially in the region where antigen was injected. The antigen thus fails to prevent infection but appears to promote encapsulation of the larvae.

29. *Studies on Oxyuriasis. XI. Dermal and Intradermal Skin Reactions in Oxyuriasis.* Willard H. Wright and John Bozicevich, U. S. Public Health Service.

Antigen was prepared from adult and larval *Enterobius vermicularis* by washing the worms, drying them *in vacuo* over sulphuric acid, grinding them to a fine powder, extracting the powder with ether in the Soxhlet apparatus, and further extracting with physiologic saline solution or with a buffered saline solution. Dermal tests were made with a 1 : 100 dilution of the antigen, and intradermal tests with antigen dilutions of 1 : 500, 1 : 1000, 1 : 2000, 1 : 5000, 1 : 8000 and 1 : 10,000. Of 140 persons tested, 90 were known pinworm cases; 21, used as controls, had no worm parasites; and 29, used as controls, had infestations with worms, including *Ascaris lumbricoides, Necator americanus, Trichuris trichiura, Strongyloides stercoralis, Hymenolepis nana,* and *Schistosoma mansoni,* but not with pinworms. The formation of a wheal 5 mm. or more in diameter, with or without pseudopodia, with a negative control wheal, was considered as a positive reaction to the tests. Of the 90 pinworm cases, 37 were positive to the dermal test, 5 positive to the intradermal test with an antigen dilution of 1 : 500, 2 with an antigen dilution of 1 : 1000, 1 with an antigen dilution of 1 : 2000, and 33 with an antigen dilution of 1 : 5000. Eight individuals, negative to the dermal test, were not tested intradermally; 4 pinworm cases were negative to both tests. The data indicate the marked specificity of the dermal test. The intradermal test with antigen dilutions over 1 : 5000 was not reliable in provoking positive reactions in pinworm patients. With antigen dilutions up to and including 1 : 5000, some patients infested with one or more species of worms, but not with pinworms, gave positive intradermal reactions.

30. *A Parasitological Reconnaisance in Alaska with Particular Reference to Varying Hares.* Cornelius B. Philip, Rocky Mountain Laboratory, U. S. Public Health Service.

A total of 172 varying hares were taken June 11 to July 28, 1937, at various points in Alaska including the Kenai Peninsula, Fairbanks, along the Steese highway to Circle, down the Richardson highway to Chitina, Cordova, and Lake Bennett, Yukon Territory; 45 of these were females carrying 3 to 7 foetuses (mean 4.9) as late as July 23; 54 additional were lactating; only 32 were adult males. An approach to peak abundance was indicated in the present cycle in most localities. Endoparasites, larval *Taenia pisiformis* and adult *Cittotaenia pectinata americana,* were rather wide spread, while the nematode, *Passalurus nonanulatus* was only seen once near Gulkana. Ectoparasites were much more localized; rabbit ticks, *Haemaphysalis leporis-palutris,* were even moderately abundant only in one restricted area near Fairbanks, whereas fleas, *Hoplopsyllus glacialis lynx,* occurred sparsely only on hares from the Steese and Richardson highways. Mites were almost never taken. Tularaemia and an infection of

as yet unknown pathogenicity were recovered from rabbit ticks from the Fairbanks area by appropriate laboratory procedure. It is not clear how arthropod-borne disease could act under present conditions or in the near future in the wide-spread decimation of the present generation following the well-known hare cycles. Among observations on parasites of other wildlife, the following are of interest: *Ascaris tarbagan* from the ochraceous woodchuck near Fairbanks; *Diandrya* sp. (probably *composita*) from hoary marmots; *Taenia hydatigena* cyst from a Dall sheep, Rapids; *Dermatoxys* sp. from pika (rock rabbit); the tick, *Ixodes angustus,* from red-backed mice, Kenai; *Contracaecum* sp. (probably *spiculigerum*) from double-crested cormorants, Skilak Lake; and bloodsucking maggots, *Protocalliphora* sp., from a golden eagle nest, Rapids.

31. *Status of the Generic Name* Profilicollis *of A. Meyer.* Harley J. Van Cleave, University of Illinois.

In 1931, A. Meyer proposed the name *Profilicollis* for a generic concept. At first the present writer was inclined to accept *Profilicollis* as a valid genus in spite of Witenberg's (1932) statement that it is a synonym of *Polymorphus.* Study of extensive collections of related Acanthocephala, including several undescribed species, has convinced the writer that *Profilicollis* cannot be separated from *Polymorphus* as a generic concept. When Meyer (1933: 529) attempted to prepare a key to the genera of Acanthocephala, he brought *Profilicollis* and *Polymorphus* down as an unresolved complex and was unable to point out any significant differences between them. I therefore assign *Filicollis botulus* and *F. arcticus* to *Polymorphus* and they should be designated as *Polymorphus botulus* (Van C., 1916) n. comb., and *Polymorphus arcticus* (Van C., 1920) n. comb.

32. *The Life Cycle of a Trematode of Frogs.* W. Henry Leigh, University of Illinois.

The life history of *Glypthelmins quieta* Stafford, 1900, has been experimentally determined. The cercaria, one of the ornate Xiphidiocercariae, has been identified as *Cercaria mesotyphla* Miller, 1935. Natural infections of this cercaria have been found in *Physa gyrina* and *P. gyrina hildrethiana* in the vicinity of Urbana, Illinois. The amphibian genera *Rana, Hyla* and *Pseudacris* have been reported in the literature as definitive hosts for *G. quieta.* In the present study experimental infections have been secured in *R. pipiens* and *R. catesbeiana.* The cercariae penetrate the skin of the amphibian and become encysted just beneath the outermost layer. They are cast off with the shed skin. The worms reach the digestive tract of the definitive host when the host ingests the cast skin. The eggs of *G. quieta* are embryonated when they leave the uterus and hatch apparently only when eaten by the snail host. Miracidia as well as empty egg shells have been observed in the dissected gut of snails. Experiments involving attempts to infect the tadpoles of *R. pipiens* and *R. catesbeiana* were negative. A detailed account of this life history will be published elsewhere.

33. *A New Strigeid Cercaria which Produces a Bloat Disease in Tadpoles.* W. W. Cort and Sterling Brackett, Johns Hopkins University and University of Wisconsin.

A new strigeid cercaria, which will be described in a later publication, has been found very rarely in *Stagnicola palustris elodes* (Say), *Stagnicola emarginata angulata* (Sowerby), and *Stagnicola exilis* (Lea) in the Douglas Lake region, Michigan. This cercaria penetrates into tadpoles and develops in about 10 to 16 days into a metacercaria of the diplostomulum type. The diplostomula are found in the body cavity and widely distributed in the tissues. Very heavy infections cause severe symptoms producing a condition to which we have given the name of "bloat disease." In such cases the abdomen becomes very much bloated and greatly distended with gas. As this condition is developing the tadpole becomes very sluggish, loses its equilibrium and floats on its back. Death

usually occurs a few days later. Examination of these tadpoles shows accumulations of gas in the tissues surrounding clumps of the metacercariae. There are also small hemorrhagic areas. These severe symptoms leading to death only occur in tadpoles given extremely heavy infections and begin to show up 8 to 10 days after the penetration of the cercariae. Most of the experimentally infected tadpoles continue to live for a month or more and show only a slight bloating. Although a number of attempts were made to obtain the adult of this trematode by feeding the diplostomula to different birds and mammals, up to the present all the experiments have been negative.

34. *Experimental Studies on Trematodes Belonging to the Subfamily Reniferinae.* J. HENRY WALKER, University of Alabama.

Experiments showed the necessity for incubation of eggs during the colder months of the year. Other experiments demonstrated natural incubation of eggs while the trematodes were in the mouth of the snake-host. The average daily egg-production per trematode and the total egg-capacity of the uterus were determined. The morphology of the snail host, *Physa halei,* was studied. After the ingestion of fully developed eggs of *Renifer aniarum* (Leidy, 1891) and *Dasymetra villicaeca* Byrd, 1935, large numbers of the appropriate snail hosts were killed and fixed at regular intervals. A complete examination of stained serial sections has shown (1) hatched eggs in the crop-gizzard, stomach and intestine of the snail; (2) free-swimming miracidia in the stomach and intestine; (3) miracidia attempting to penetrate and depressing the epithelium of the stomach and intestine; (4) miracidia between the epithelium and the surrounding connective tissue of the stomach and intestine; (5) the transformation of the miracidia into mother-sporocysts; and (6) all stages up to the emergence of the cercariae. The consistent evidence, stage by stage, of the hatching, penetration and metamorphosis phenomena within the snail indicates for the first time the exact locations and methods by which the snail becomes infected with these Reniferine trematodes. Information is now available indicating the method by which those families of trematodes whose eggs do not hatch *in vitro* are able to infect appropriate snails and to proceed with development within these molluscs.

35. *Life Cycle of a Fluke* Halipegus eccentricus *n. sp., Found in the Ears of Frogs.* LYELL J. THOMAS, University of Illinois.

Investigations begun in 1932 clearly demonstrated that *Halipegus eccentricus* n. sp. is a larger fluke than *H. occidualis,* redescribed by Krull (193) in which he also gave the life cycle. The cystophorous cercariae differ markedly in *Halipegus eccentricus* in that they possess two long filamentous streamers in addition to the excretory tubes. The metacercariae evert a urinary bladder lined with villi while in the body cavity of the cyclops. This seems to be a regular functional activity of the species. Experimental evidence demonstrates that the regular life cycle is as follows. The adult fluke in the Eustachian tube of the frog gives off fully embryonated eggs which pass out by way of the digestive tract and are eaten by the following snails: *Physella parkeri* Currier, *P. sayii crassa* Walker, *P. gyrina,* and *Helisoma trivolvis.* The spine-covered miracidium penetrates through the intestinal wall, becomes the sporocyst, which gives rise to two or three rediae. These in turn develop cystophorous cercariae, the entire stage in the snail requiring one month or more. Cercariae picked up by *Cyclops leuckarti* and *C. vulgaris* develop in the body cavity in two weeks time to the infective stage. Tadpoles, sucking up the cyclops free the metacercariae in the stomach where they stay until metamorphosis, when development proceeds and migration brings them into the ears.

36. *Life History Studies and Their Relation to Problems in Taxonomy of Digenetic Trematodes.* GEORGE R. LA RUE, University of Michigan.

President's address.

37. *Some Useful Paraphernalia in Parasitological Entomology.* CORNELIUS B. PHILIP, Rocky Mountain Laboratory, U. S. Public Health Service.

Exhibits are provided of (1) an improved mosquito cage for small animal experimentation, (2) a convenient colony method for rearing haematophagous bugs, (3) "collecting-cones" for temporary attachment to standard glass tubes facilitating recovery and rapid transfer of small biting flies, such as black-flies from the ears of horses, (4) demonstration of the "capsule" technique for tick experimentation and rearing on small animals.

38. *Studies on Agricultural Sanitation in North China.* GERALD F. WINFIELD, Cheeloo University, Tsinan, Shantung, China.

This paper is to be presented as a movie with a running explanation which illustrates the main features of a program of work directed at developing new agricultural methods for sanitating cities and villages in North China. Work is being carried on on four phases of the problem: 1. Epidemiology of fecal-borne diseases; 2. Fly breeding and population studies; 3. Composting as a new method of fecal disposal; 4. Design of a sanitary latrine that will meet the demands of the agricultural sanitation program. In the epidemiological studies ascaris has been successfuly used as a sanitary index in city and country areas. One of the main objectives of the fly population program has been to develop quantitative methods for using fly density as an additional sanitary index. In the composting experiments four different methods have been studied comparatively and it has been demonstrated that fermentation heat can be used successfully to sterilize household wastes including fecal material. The destruction of ascaris eggs has been used as the criterion of effectiveness in sterilizing the wastes in the compost heaps. Field tests have been run on the fertilizers produced as well as extensive chemical studies both on the new methods being studied and the methods of fertilizer production now in common use. A modified bucket latrine has been developed.

39. *Some Effects of Invasion by Myxosporidia on Certain Canadian Fishes.* H. B. FANTHAM AND ANNIE PORTER, McGill University.

Some pathological effects of invasion by Myxosporidia have been demonstrated in Canadian suckers, *Catostomus* spp., various minnows belonging to the genera *Hyborhynchus, Rhinichthys, Pimephales, Couesius, Notropis* and *Chrosomus,* pike, *Esox* sp. and darter, *Oligocephalus.* Cysts, tumours or nodules produced by the parasites, chiefly *Myxobolus* spp., in many parts of the bodies of these fishes vary in size from microscopic to hazel nuts. Coelomic mesenteric cysts are often of large size, almost filling the abdomen in some minnows. The musculature of the body wall and the skin, especially near the fins, are common sites of tumour formation. Less usual sites are the cheek, roof of mouth, eye orbit, nasal areas and mandibular bones. Small glistening nodules due to *Henneguya* spp. occur on branchial filaments. Gall bladder infections with Myxosporidia cause marked thickening and fibrosis, with destruction of the surrounding tissue, considered to be hepatopancreatic in function. Leucocytic infiltration of muscular and subcutaneous tissues follows their invasion by Myxosporidia but is usually insufficient to inhibit multiplication by the parasites. Tissue degeneration with pus formation occurs, while the host reacts by producing fibroblasts that ultimately form fibrous tissue enveloping masses of multiplicative forms, spores, pus and cellular débris. In such tumours young parasites are found peripherally and mature spores at the centre of the tumour. Infected muscle fibres show attenuated sarcoplasm and nuclear deformation. Intermuscular parasitic masses cause progressive atrophy of adjacent fibres. Skin and subcutaneous tumours may rupture to the exterior and secondary bacterial invasion occur. Bone erosion due to Myxosporidia is noticeable.

40. *Microgamete Formation of* Haemoproteus beckeri *in the Blood of the Brown Thrasher* (Toxostoma rufum). ROBERT L. ROUDABUSH, Iowa State College.

A Brown Thrasher shot and wounded at Ames, Iowa, was found to be parasitized by *Haemoproteus beckeri.* A hasty examination of the first smears made showed what was apparently microgamete formation taking place in the blood. To be certain that gametogenesis was not instigated by the cooling of the blood, more smears were made and studied. Such examinations were made periodically for six days and the microgametes were found several times in both fresh and fixed material. On the sixth day the bird was killed. Since gametogenesis was found occurring through such a period of time the observation shows that at least microgamete formation of *Haemoproteus beckeri* can take place in the blood of the vertebrate host.

41. *Modifications of the Acetabulum in Trematodes.* H. W. Manter, University of Nebraska.

Modifications of the acetabulum in trematodes is not infrequent, especially in the family Allocreadiidae and in the subfamily Opecoeliinae. These modifications are usually in the form of papilla-like or finger-like processes on the lips of the aperture, or accessory folds of the body wall near the acetabulum. The papillae may consist of but one large pair or may be as many as nine pairs. *Myzoxenus* Manter, 1934, has peculiar longitudinal bands in the sucker and in one (new) species there are two conspicuous lateral jaws. In the Heterophyidae the acetabulum is frequently deeply embedded in the body while in some Allocreadiidae it is located on a long stalk. The acetabulum may be extremely modified (without aperture) in some Fellodistomidae as *Discogaster* Yamaguti, 1934, or, in *Bivesicula* Yamaguti, even completely lost, thus again illustrating the heterogeneity of monostomes.

42. *Further Studies on Prosthogonimiasis.* Ralph W. Macy, College of St. Thomas, St. Paul, Minn.

Of five turkeys fed cysts of *Prosthogonimus macrorchis,* four developed prosthogonimiasis; the fifth lost most of its infection due to the change of the oviduct to the resting condition. One turkey was fed twenty dragonfly naiads of the genus *Tetragoneuria* naturally infected with *P. macrorchis,* and twelve days later 236 medium-sized, mature specimens of the fluke were recovered from the oviduct. The disease in turkeys was found to be similar to that produced by the same parasite in chickens (Macy, 1934, Minn. Ag. Exper. Station Bul. 98). Naiads of the dragonfly *Gomphus spicatus* Hagen were found to be additional, important, intermediate hosts for *P. macrorchis.*

43. *Cystocercous Cercariae of the Mirabilis Group from Lake Erie Snails.* E. Eugene Dickerman, Bowling Green State University.

Several very interesting forms of parasites have been discovered during the past three summers in *Goniobasis, Pleurocera* and *Campeloma* snails of the Bass Island Region of Lake Erie. At the present time only the Cystocercous cercariae of the Mirabilis Group will be demonstrated. *Cercaria macrostoma,* the larva of *Proterometra macrostoma,* shows numerous variations, three very distinct ones being found in the cercariae from *Goniobasis* and *Pleurocera* snails of Lake Erie. *Cercaria stephanocauda,* the larva of *Leuceruthrus micropteri,* has been found in *Pleurocera* snails only. *Cercaria brookoveri,* heretofore known only as immature forms from *Campeloma* snails, has been rediscovered and incomplete feeding experiments indicate that it will ultimately be found to develop into *Azygia longa. Cercaria angusticauda,* nov. sp., was discovered in *Goniobasis* snails; the above name being suggested because of the morphological similarities between the distome portion of the larva and *Azygia angusticauda. Cercaria sagittaria,* nov. sp., is larger than any cercaria yet described, being 20–22 mm. in length. It has been found in both *Goniobasis* and *Pleurocera* snails and develops, experimentally in fish and turtles, into *Proterometra sagittaria,* nov. sp.

44. *Some Cystocercous Cercariae from Alabama and Florida.* SEPTIMA SMITH, University of Alabama.

The cercariae demonstrated represent several species studied and previously described by the author.

45. *Giant Trematodes from the Wahoo,* Acanthocybium solandri. ROSS F. NIGRELLI AND H. W. STUNKARD, New York Aquarium and New York University.

Nine specimens ranging from 7 to 65 mm. in length have been collected from the stomach of *A. solandri.* Four were taken in the Bermuda region and five near the coast of Yucatan. The material appears to belong to a single species. One specimen 15 mm. in length cut in serial sections is sexually immature. Two specimens, each over 60 mm. in length, will be demonstrated. These trematodes belong to the *D. clavum* group and show substantial agreement with the description of *Hirudenella fusca* as given by Manter and *H. beebei* as described by Chandler.

46. *Studies on the Life History of* Neoechinorhynchus cylindratus (*Van Cleave, 1913*). HELEN L. WARD, Purdue University.

A part of the life cycle of *Neoechinorhynchus cylindratus* (Van Cleave, 1913) has been traced experimentally and the remainder appears evident from recent observations. Two specimens of *Huro salmoides* were isolated for over four months, and then fed young bluegills (*Lepomis pallidus*) on two successive days, after repeated examinations had demonstrated that a high percentage of the bluegills were infected with acanthocephalan larvae localized in the liver. Six days after the first feeding an examination of one of the bass revealed young Acanthocephala, some of which were little more advanced than the larvae recovered from the liver of the intermediate host. The first intermediate host appears to be an ostracod since four of eight hundred specimens collected in the field and dissected were found to be naturally infected with a larval acanthocephalan showing marked similarities to the second larval and adult stages of *N. cylindratus.* The experimental infection of ostracods is being undertaken, utilizing eggs of *N. cylindratus* recovered from the second experimentally infected bass.

47. *Studies on Oxyuriasis. XII. Epidemiological Findings in Washington, D. C.* ELOISE B. CRAM AND LUCY REARDON, National Institute of Health, U. S. Public Health Service.

Anal swab examinations on approximately 2000 persons from the general population of Washington, D. C., have shown approximately 40 per cent infested with pinworms. The geographical distribution of these cases has been plotted on maps of the city, and the distribution by age, sex and race has been shown on graphs. The anal swab used for diagnosis is exhibited, together with microscopic preparations from the swabs.

48. *The Larval Production of* Trichinella spiralis *in Rats given Graduated Numbers of Larvae.* L. O. NOLF AND J. M. EDNEY, University of Iowa.

Rats were given larvae of *Trichinella spiralis per os* in graded doses. A total of 196 rats survived the six weeks period allowed for the infestations to develop. The rats were then killed and the larvae recovered by digestion of the carcasses. Counts were made of the larvae both directly and by dilution methods. The average infestation recovered from a group of rats receiving the same dose was determined by the equation $\sqrt{\frac{EX^2}{N}}$. The results obtained are here given: *larvae fed / average infestation;* 20 / 4809; 40 / 4472; 80 / 6808; 160 / 12385; 320 / 20321; 640 / 83261; 1280 / 140515; 2250 / 151743; 4500 / 393041; 9000 / 694575.

49. *Studies on Forced Calcification in Experimental Trichina Infections.* THEODOR VON BRAND, G. F. OTTO, AND EVELYN ABRAMS, Johns Hopkins University.

Calcification of the fibrous host capsule was readily produced in four-month-old trichina infections in rats with fatal doses (500–1800 units) of parathormone. In no case, however, was there any evidence of calcium deposits within the cyst itself. That larvae were unaffected by the treatment was demonstrated by feeding experiments in which larvae from treated rats produced both intestinal and muscle infections comparable to those produced by larvae from untreated animals. With comparable doses of parathormone much less calcium was deposited in cyst walls of one-month infections and none was seen associated with the unencapsulated larvae in 14-day-old infections. Evidence of actual calcification of larvae was seen in only two cases, once in a parathormone treated rat and once in an untreated control. In both cases histological study suggested that calcification had followed rather than caused the death of the larvae. The death of the rats in these experiments must be attributed to the parathormone. Extensive calcification was seen in the vascular bed, kidneys, and other organs on autopsy. We feel that attempts at forced calcification with parathormone, and probably with any other substance, as a therapeutic measure is not only futile but dangerous.

50. *Studies on the Oral Transfer of* Sparganum mansonoides *and on the Nature of* Sparganum proliferum. JUSTUS F. MUELLER, New York State College of Forestry.

Spargana of *Diphyllobothrium mansonoides* from experimentally infected mice were fed to green frogs, white mice, white rats, and rhesus monkeys. In frogs the spargana failed to set up an infection and eventually passed out of the body with the feces. In mice, rats, and monkeys, however, the spargana penetrated the intestinal wall and reestablished themselves in the tissues. Spargana fed to and recovered from mice in this manner 5 times in succession apparently suffered no loss of vitality. It has now been determined that the monkey is susceptible to oral infection with the procercoids of *D. mansonoides*. Cross sections of *Sparganum mansonoides* show 2 longitudinal excretory canals and 2 longitudinal nerve cords. In *S. proliferum* these structures are lacking. In *S. mansonoides* the elements of the medullary portion are definitely organized, but in *S. proliferum* they are disorganized and chaotic as in a malignant tumor. In *S. mansonoides* injury of the scolex leads to degeneration of the nerve cords, and sometimes to abnormal shapes, and such spargana fail to develop when fed to definitive hosts. Because *S. proliferum* lacks nerve cords the "heads" are not equivalent to normal spargana and do not develop when fed to definitive hosts. *S. proliferum* is a teratological larva, probably a form of *S. mansoni* or *S. mansonoides* which grows and branches indefinitely under the influences of some abnormal stimulus.

51. *Rates of Acquisition by Grazing Sheep of* M. expansa *and What They Reveal of the Available Pasture Infestation.* NORMAN R. STOLL, Rockefeller Institute, Princeton, N. J.

Characteristic of *Moniezia expansa* infection is the promptness and apparent regularity with which sheep grazing in an infested field contract the cestode. On a per diem basis, the number of worms acquired is small, as judged by post-mortem examination of susceptible animals which have been exposed seriatim and killed before becoming immunized. Throughout a two years' study in our field I–II, for only one brief period did this daily number definitely exceed 2 tapeworms. Comparative rates of acquisiton of the parasite may be taken as reflecting changes in the amount of available pasture infestation. A rapidly rising rate as forage developed in the spring, was concomitant with increased grazing by the sheep. (During winter feeding of hay, even though the animals had the run of the pasture, infection was possible, though rare.) After an interval, a rapidly falling rate appeared to evidence gradual exhaustion of the infestation, coming as it did when no tapeworm eggs had been deposited for many months

in the area. A secondary rise in the rate, as the season advanced, was subsequent—after a lag period—to new contamination of the field. In a year when there was no interruption of the recontamination of pasture by active infections, there was no evidence of temporary exhaustion of the infective stages. The picture developed was a consistent one, in which duplicate animals at various exposure periods furnished confirmatory observations.

52. *The Life Cycle of Anoplocephaline Cestodes.* HORACE W. STUNKARD, New York University.

Studies have been carried on using species of *Cittotaenia* from rabbits and *Moniezia expansa* from sheep. Eggs from feces contain active onchospheres. These larvae remain alive and active after repeated passages through the intestine of the definitive hosts. Treatment of eggs with chemical agents and physical conditions ordinarily encountered in nature did not affect the activity of the onchospheres. Although chemical substances would not induce hatching, mechanical injury of the shell caused emergence of the larvae in a large percentage of cases. The onchospheres measure approximately 20 microns in diameter. Young tapeworms, 0.3 mm. in length and only slightly farther advanced than the cysticercoid stage, were recovered from naturally infected rabbits. Previous literature on the life history of anoplocephaline cestodes was analyzed to determine the conditions under which infection naturally occurs and thus to discover the characteristics of the intermediate host. Various terrestrial invertebrates, chiefly insects, have been used in attempts to complete the life cycle of *Cittotaenia* and *Moniezia*. In the spring of 1936 cestode eggs were fed to tyroglyphid and oribatid mites and larvae of both these tapeworms were found in the body cavity. Eggs of *M. expansa* were fed to specimens of *Galumna* sp. (*Zetes* sp.) and a series of developmental stages, from the onchosphere to the cysticercoid, have been recovered from the body cavity. In one instance, mites previously exposed to *Moniexia* eggs were fed to a lamb which became infected.

53. *Studies on the Bionomics and Seasonal Incidence of* Trichostrongylus axei *(Cobbold).* M. A. STEWART AND J. R. DOUGLAS, University of California.

Eggs of *Trichostrongylus axei* maintained at a constant temperature of 100 degrees F. hatched and viable larvae were observed up to 96 hours after the eggs were exposed to this temperature. Eggs maintained at a constant temperature of 22 degrees F. hatched and viable larvae were again observed up to 96 hours. *T. axei* eggs submerged in water to a depth of 15 mm. and kept at room temperature remain viable for 20 days. Eggs kept in thoroughly dry sheep feces remain viable for more than 193 days at room temperature. Non-infective *T. axei* larvae are killed when dried for 30 minutes at 80 degrees F. Infective larvae immersed in tap water remain alive 408 hours at 100 degrees F.; they remain viable 192 hours in moist sheep feces at this temperature; in dry feces they die within 48 hours. Infective larvae can successfully withstand submergence in water at room temperature for 231 days but die in 16 days when dried at the same temperature. Larvae of this stage live for more than 137 days in moist soil at room temperature. Infective larvae manifest no phototropic responses. These data are used in an attempt to explain the fall and winter peaks of *T. axei* infestations in sheep on irrigated pastures in California.

54. *Studies on the Course of Trichostrongle Infestation in Sheep.* H. S. CAMERON AND M. A. STEWART, University of California.

Lambs, weaned from ewes at 24 hours of age, were reared on bovine milk and maintained under quarantine conditions in quarters with concrete floors that were swept daily and disinfected weekly. They were free from trichostrongyles as determined by fecal examinations. At various ages ranging from 1 to 4 weeks they were infested orally with a known number of infective larvae in gelatin capsules. Non-infested lambs mingled with the infested lambs as a control on reinfestation. The larvae consisted chiefly of *Ostertagia circumcinta* and *Trichostrongylus colubriformis.* A few *Oesophagostomum* sp. were present. Fecal samples were taken daily from

infested lambs and controls. Egg counts were made, first by flotation and then, when justified by numbers, by a modified Caldwell technique. Results indicated that lambs one week old were susceptible to trichostrongyles and that the intrinsic incubation period of the parasite including the passage of the eggs along the alimentary tract was approximately 20 days. The degree of daily fluctuation in egg counts was great, indicating the necessity of taking this factor into consideration when estimating the efficiency of an anthelmintic by an egg count. The curve, in general, represented a series of peaks, the apices of which gradually decreased. In all instances negative phases occurred followed by sudden rises and then equally sudden drops. The length of some of the negative phases made it difficult to determine the duration of patency. The shortest duration encountered was 120 days followed by 77 days of negative fecal examinations. The variation in the duration of patency is shown in the fact that another animal is still passing eggs 200 days after infestation. Controls were negative at all times.

55. *Some Observations on the Epidemiology of the Dog Heart Worm* (Dirofilaria immitis). HAROLD W. BROWN, University of North Carolina.

Examination of dogs for *Dirofilaria immitis* were made in rural and urban areas in and about Savannah, Georgia. The examinations disclosed that *Dirofilaria* was present in as many as 80 per cent of the dogs in certain areas. Studies made on the type of dog most commonly infected indicate that the usual text-book statement of a higher infection rate among short haired dogs than long haired dogs does not hold for the region studied. Observations were made on the development of the *Dirofilaria* microfilariae in dog fleas.

56. *Seasonal Changes in the Frequency with Which Single* Strongyloides ratti *Produce Progeny of Indirect Development.* GEORGE L. GRAHAM, The Rockefeller Institute, Princeton, N. J.

It has been shown (Graham, in press) that *Strongyloides ratti,* established in the laboratory rat by means of a single larva of homogonic development, produced heterogonic progeny, *i.e.,* free-living males and females, throughout the life span. The environment encountered by the larvae in the fecal cultures played no significant part in determining the mode of larval development pursued by the progeny. Data, gathered more or less continuously through three summers and two intervening winters since March, 1935, revealed, however, a marked seasonal change in the *percentage of days* on which cultures containing adults of indirect development appeared. In 1935, this percentage reached a maximum in July (41 per cent), then declined to less than 10 (October–January, 1935–36); increased in 1936 to a maximum in July (34 per cent) and again declined to less than 10 (November–April, 1936–37). In August, 1937, 46 per cent of all cultures yielding one or more offspring contained heterogonic progeny. At the present time the characteristic post-summer regression is in progress. Graphically, three monthly percentages, derived from over 6,000 suitably incubated 24-hour fecal collections from 125 single *S. ratti* infections, thus describe a definite bimodal annual cycle with extremes approximately six months apart. As independent evidence indicates that the fecal cultures are not responsible, the results suggest that the mode of larval development in *S. ratti* is determined by a labile chromosomal mechanism in the parasite responding to environmental stimuli within the rat.

57. *Infection of Guinea-Pigs with* Strongyloides ratti. A. J. SHELDON AND G. F. OTTO, Johns Hopkins University.

Larvae or adult worms were recovered from 5 out of 18 guinea-pigs given infective larvae of *Strongyloides ratti* percutaneously or subcutaneously. Adult worms were found in the lungs of two animals, together with rhabditiform larvae in one and with filariform larvae in the other. Filariform larvae alone were recovered from the lungs of a third animal and from fecal cultures made at autopsy of two others. Rhabditiform adolescent worms were also obtained in one of these cultures.

No adults were found in the intestinal tract despite the fact that this was the only place they were found in rats and mice infected with the same strain of *S. ratti.*

58. *The Development of* Zygocotyle *from* Cercaria poconensis *Willey, 1930.* CHARLES H. WILLEY, New York University.

Cercaria poconensis Willey, 1930, from *Helisoma antrosum* encysts on vegetation or other objects in the water. These metacercariae were fed to 6 young laboratory-raised rats and to 3 young ducks and continued their development. Three of these rats when killed 5, 8 and 11 days respectively after the experimental feeding, contained in the caecum large numbers of young worms of the genus *Zygocotyle.* Fifty-nine worms found in the rat which was killed after 5 days measured from 0.810 mm. to 0.884 mm. in length, and an increase in size was noted in each of the other infestations. Those collected after 11 days in the rat were from 2.0 mm. to 2.5 mm. long. A duck sacrificed 14 days after the experimental feeding harbored in the caeca young worms which were in a slightly later stage of development than those which lived for 11 days in the rat. Since none had reached sexual maturity after 14 days in a host, the rest of the infected hosts are being held longer to await the development of the worms to maturity, after which experiments with laboratory-raised snails will be undertaken to complete the cycle. The young worms obtained to date after 14 days' development agree in all respects with *Zygocotyle lunatum.*

59. *Some Monogenetic Trematodes from the Galapagos Islands and the Neighboring Pacific.* FRANK G. MESERVE, Macalester College, St. Paul, Minn.

A study of twenty-two species of Monogenea collected from the gills of marine fish by Dr. H. W. Manter who was a member of the G. Allan Hancock Expedition to the Galapagos Islands in 1934. Collection was made from examination of over 500 fish representing approximately 100 species. Twenty new species are described. All are placed in known genera with one exception. Two previously described species are reported from new localities. One new genus is proposed.

60. *Studies on Oxyuriasis. XIII. Problems Presented by a Family of Seven, All Infested with Pinworms.* MYRNA F. JONES, ELOISE B. CRAM AND WILLARD H. WRIGHT, National Institute of Health, U. S. Public Health Service.

Observations on a family of 7 persons infested with pinworms were made during a 10-month period. The family belonged to a low-income group. Various treatments were given and approximately 800 examinations made. For diagnosis, anal swab examinations were much more reliable than stool or fingernail examinations. Observations and collections of migrating worms, made by the mother at night, gave supplementary information. Of the 7 persons, 4 were positive on the first anal swab, 2 were positive on the second, and 1 was not positive until the 7th swab, made the 13th day after the first examination. At some time during the study, 5 individuals were apparently freed of the infestation for varying lengths of time; the remaining 2 were never negative for more than 10 or 15 days or for more than 5 successive examinations; there was no time at which every member examined was negative. There was, apparently, a constant source of reinfestation, and the efficacy of treatments could not be determined due to this complicating factor. For swab examinations as a reliable index of "heavy" or "light" infestations, it appeared necessary to make as many as 20 swabs, during a 3- to 4-week period, or daily swabs during 2 to 3 weeks. The study, above all, emphasizes the necessity of making diagnostic examinations on every member of the family, of treating all infested persons simultaneously, and of instituting adequate preventive measures. It illustrates the difficulties encountered under conditions of inadequate income, restricted living quarters, and poor sanitary facilities.

61. *Further Studies on the Life Cycle of* Contracaecum spiculigerum. LYELL J. THOMAS, University of Illinois.

Guppies, *Labistes reticulatus,* were experimentally infected by the direct feeding of *Contracaecum spiculigerum* larvae. These in turn were used to infect common fledgling cormorants, *Phalacrocorax auritus.* Laboratory mice, when examined two days after being fed infected fish had active *Contracaecum* larvae in the mucosa of the stomach.

62. *Life Cycle of* Raphidascaris canadensis SMEDLEY, 1933, *a Nematode from the Pike,* Esox lucius. LYELL J. THOMAS, University of Illinois.

Experiments and observations show that this nematode lays its eggs in the intestines of the pike in the morula stage. The eggs pass out into the open with the feces and at temperatures between 75° and 80° F. become embryonated within eight hours. After one molt in the egg they are infective to minnows and perch, which are bottom feeders. In these fish they are walled off in the mesenteries and liver to continue growth until eaten by the pike, *Esox lucius,* when the cycle is completed.

63. *Physiological Observations on a Larval* Eustrongylides. THEODOR VON BRAND, Barat College, Lake Forest, Ill.

The worms with which the experiments were performed were found in fibrous capsules attached to the mesenteries of *Fundulus heteroclitus.* They belong to the genus *Eustrongylides* and were first described by Mueller. Their chemical composition is characterized by its high glycogen and low fat content, and the fact that great amounts of haemoglobin occur in the body fluid. Both the aerobic and anaerobic glycogen consumption are lower than in Ascaris. But the worm uses under aerobic conditions much less glycogen than under anaerobic ones—contrary to what is found in Ascaris. It resembles in this respect free-living forms. This is probably connected with the presence of haemoglobin, which will secure oxygen also under the difficult respiratory conditions under which the organism lives. The worm is able to keep its glycogen level high, even if the host starves during 60 days and loses during this period half of the glycogen.

64. *Studies on Host Reactions to Larval Parasites. III. An Histolytic Ferment from the Cercariae of* Cryptocotyle lingua (*Creplin*). GEORGE W. HUNTER, III, AND WANDA S. HUNTER, Wesleyan University.

In a study of host reactions a series of experiments were run to determine whether or not the cercariae of *Cryptocotyle lingua* secreted an histolytic ferment. An extract of the cercariae of *C. lingua* was prepared by maceration and filtration. As these cercariae normally penetrate the fins of their hosts small pieces from the fins were exposed in hanging drops to the filtrate secured from the macerated cercariae. Bits of fin from the cunner, tautog, flounder, *Fundulus,* scup and toadfish were studied. The latter three were included for comparison as they are not normally hosts for this parasite. All preparations (experiments and controls) were kept in an ice box at 6° C. between 3 and 5½ hours depending upon the experiments. Observations at the termination of the experiments showed marked evidence of karyolysis in the cunner, tautog and flounder. Changes in *Fundulus* were less striking although there was some evidence of nuclear injury. The cercarial extract had no marked effect upon the tissues of the scup and toadfish. The nuclei and cells were intact in all of the control pieces examined. Therefore it is concluded that (1) there is evidence for the presence of an histolytic ferment in the cercariae of *C. lingua* and (2) that the fins of the fish which were tested varied in their susceptibility to this cercarial extract.

65. Trichinella spiralis *and* Leptospira icterohemorrhagiae *in the Hawaiian Islands.* JOSEPH E. ALICATA, University of Hawaii.

The recent demonstration of trichinae in man and animals in Hawaii (Alicata, 1937) instigated a survey to determine the prevalence of this parasite in

animals. Of 61 domesticated hogs and 41 wild hogs examined from the Island of Hawaii, 1 and 6, respectively, were found infected with trichinae; of 2130 rats and 70 mongooses examined, 57 and 17, respectively, showed infection. Of 1094 rats and 22 mongooses examined from Maui, 1 and 2, respectively, were infected. *Leptospira icterohemorrhagiae* has recently been demonstrated in Hawaii. These spirochaetes were noted in the urine of a plantation worker hospitalized for jaundice at Pepeekeo, Hawaii; the sediment of this urine was also injected intraperitoneally into a guinea pig. The animal died of jaundice after nine days; darkfield examination of the kidney and liver smears, and stained sections of these organs revealed *Leptospira* organisms. A brief survey was conducted to determine the presence of *Leptospira* in rodents from the plantation in which the above patient worked. The emulsion of each kidney from 30 rats was smeared on the shaved and scarified skin of a guinea pig. Of these 30 animals inoculated, 5 died of leptospirosis. *Leptospira* organisms were also noted in rats trapped on the Island of Kauai. Since the original discovery of infectious jaundice in Hawaii (October, 1936), there have been reported by physicians up to October, 1937, the following cases of this disease in man: Hawaii, 52 cases; Kauai, 2 cases; Maui, 2 cases. (The above research was financed by the Hawaii Territorial Board of Health.)

66. *Studies on the Development of the Pigeon Capillarid,* Capillaria columbae. Everett E. Wehr, U. S. Bureau of Animal Industry.

Capillaria columbae is a common parasite of the small intestine of domestic pigeons and occurs occasionally also in turkeys and chickens. Transmission is direct, approximately 3 weeks being required to complete the cycle. Eggs in either tap or distilled water embryonate normally in 6 to 8 days at room temperature (20° to 24° C.). The embryo has not been observed to molt in the egg. The first-stage larva possesses a stylet, and a cell body consisting of 2 rows of opposing cells; in all succeeding stages, the stylet is apparently absent and the cell body consists of only a single row of cells. The relative lengths of the esophagus and intestine in the first-stage larva is approximately 3.5 : 1, but, owing to the more rapid growth of the intestinal region in the succeeding stages, the length of the latter slightly exceeds that of the esophageal region in the adult stage. Studies on the viability of ova under different environmental conditions indicated that air drying and sunlight are lethal. Both fresh and embryonated eggs are very tolerant of cold. Cultures of non-embryonated eggs exposed to a temperature of −5.6° to −9.4° C. for 35 days yielded several embryos when these eggs were subsequently held at room temperature for several days, and cultures exposed to a temperature of 2° to 5° C. for 96 days yielded many embryos. Heavily infested pigeons assume a huddled position underneath the roosts or in some corner away from the rest of the flock. Food and water are taken sparingly and the birds gradually become greatly emaciated. Death is the ultimate result. Post-mortem examinations of heavily infested birds showed extensive destruction of the intestinal mucosa. In the more advanced cases, the mucosa was completely sloughed off into the lumen of the intestine. The intestine of non-fatal cases showed considerable thickening of the walls, indicating severe proliferative enteritis.

67. *The Occurrence of* Trichostrongylus axei *(Cobbold) in Equines of Panama.* A. O. Foster, Gorgas Memorial Laboratory.

Trichostrongylus axei, a hitherto unrecorded parasite for Central America, was encountered 8 times during post-mortem examinations of equines in Panama. The circumstances surrounding the discovery of these cases seem significant in view of the imperfectly understood relationship of *T. axei* to the equine host. Three of the cases were from miscellaneous sources in the Republic and require no comment. One case, however, was found among over 100 army animals, while, in contrast, 4 cases were readily demonstrated among a small group of only seven horses which had been used as round-up mounts on a cattle

ranch near Panama City. These findings suggest (1) that horses may derive *T. axei* infections from direct association with cattle, and (2) that under conditions of close association between horses and cattle (presumably also certain other ruminants), *T. axei* may be a common parasite of the former host. These suggestions point to specific conditions under which *T. axei* may be an economically important parasite of equines, rather than one of rare occurrence, and support the view, expressed in recent literature by Stoll who cited precisely this example, that pasture-rotation as a method of parasite control should be evaluated with respect to the possible host-parasite relationships involved.

68. *On the Production and Migration of the Larvae of* Trichinella spiralis. L. O. Nolf and J. D. Crum, University of Iowa.

An effort was made to determine quantitatively the time of production and the numbers of larvae produced by *Trichinella spiralis*. Rats were infested *per os* with 3000 larvae each. Beginning on the fifth day after infection and on each day thereafter rats were autopsied and 1 cc. samples of blood were obtained from the left ventricle, the right ventricle and the portal vein. These were drawn in Na citrate and the larvae concentrated by centrifuging. The results of these examinations showed a surprising absence of larvae in the blood. From some examinations a few larvae were found on the 6, 7, 8, 9, 10, 15, 17 and 18 days following infection but gave no indication of the total reproductivity of the worms in the intestine. In addition, the lymph cistern, the liver and the lungs were examined by dissection and pressing between slides. Larvae were not found by this method of examination.

69. *The Transplantation of Gravid* Trichinella spiralis. L. O. Nolf, University of Iowa.

Rats were infected with *Trichinella spiralis* and on the fifth day of infection a biopsy was performed and a single gravid female removed and transplanted to the intestine of an uninfected rat. Four such transplants were made. Two rats died from post-operative septicemia. The remaining two were autopsied six weeks later and the carcasses digested. From one rat 1112 larvae were obtained and the other rat yielded 14 larvae.

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1930	Cleveland	1936	Atlantic City

IN MEMORIAM

Francis William O'Connor (1884–1937)

Workers in the field of parasitology suffered a serious loss in the death, on the second of October, 1937, of Doctor F. W. O'Connor. A unique and winsome personality, a devoted and able student of tropical medicine, a sympathetic and inspiring teacher, he has been for twenty years in the front rank of the advance against tropical diseases. The American Society of Parasitologists joins with other organizations in recording a tribute to him and to his work.

Francis William O'Connor was born May 13th, 1884, in Limerick, Ireland, the son of a physician of the same name. His father died when he was nine years old. He attended school in Dublin and entered the Royal University of Ireland in 1900. Subsequent training at St. Bartholomew's Hospital and College was followed by an internship, 1907–1908, at the Seamen's Hospital in London. During the period 1908–1910 he was resident medical officer to Sir Patrick Manson, and that association definitely determined the course of his subsequent career. After three years as medical officer in consular service at Formosa, he entered the London School of Tropical Medicine with which he was associated in various capacities until 1922. In 1913 he acted as Secretary to Sir William Leishman and on the outbreak of the World War went with British troops to France. In 1915 he was associated with C. M. Wenyon in studying amebiasis in Egypt. In 1917, as staff officer to Sir Ronald Ross, he was engaged in malarial surveys in Italy, Macedonia and England. After demobilization and under the auspices of the London School of Tropical Medicine, he conducted researches on tropical diseases, especially filariasis, in Polynesia. From 1923–1927 he was on the staffs of the International Health Board and of the Division of Medical Education of the Rockefeller Foundation. In 1928 he was appointed Associate Professor in the medical faculty of Columbia University, a position which he held at the time of his death. As a member of the staff of the College of Physicians and Surgeons he made regular expeditions to the West Indies and to the School of Tropical Medicine at San Juan, Porto Rico.

While his publications are scholarly treatises, O'Connor was not a prolific writer. He found his greatest happiness in helping others rather than in ambitious acquisition and achievement for himself. In all his work he was disposed to give more than due credit to his associates. Generous, modest, he cared little for honors and pursued his work with humility, sincerity and devotion. He was a careful, critical student of

the Protozoa and two of his best known publications are the monographs, one done jointly with C. M. Wenyon on "Intestinal Protozoa in the Near East," and the other with C. Dobell on "The Intestinal Protozoa of Man." Although interested in all departments of tropical medicine, O'Connor's chief concern was the filarial diseases. More than half of his publications are devoted to this subject. His researches on the epidemiology, symptomatology, clinical aspects and pathology of filariasis are masterpieces in the collection, analysis and treatment of data. After O'Connor's paper before the Royal Society of Tropical Medicine and Hygiene on May 19th 1932, Manson-Bahr declared "His work represents the most highly finished and elaborate study of the pathology of filariasis which has as yet appeared." At the time of his death he was engaged in the preparation of an exhaustive monograph on filarial diseases and he had reviewed the literature of all languages to obtain complete information on the subject. If Sir Patrick Manson was the "Father of Filariasis," F. W. O'Connor was a worthy son.

The association during his early years with Sir Patrick Manson, Sir William Leishman and Sir Ronald Ross made a deep and lasting impression on O'Connor. In fact, his younger son was named for Sir Patrick. O'Connor's experience in official and consular service was a thorough training in diplomacy. He was a man of the world, whose poise and gracious bearing charmed all who met him. A great story-teller, a temperamental and jovial Irishman with a fine sense of humor, an utter idealist, he had a host of warm friends. His personal qualities and professional attainment, joined with his interest in people and in medical education, made him an excellent teacher and administrator. In his death the scientific world has lost a cultured gentleman, a brilliant investigator, a sympathetic and able physician and a stimulating teacher.—H. W. Stunkard.

Dimitry Fedorovich Sinitsin (1871–1937).

The death of Dr. Dimitry Sinitsin on October 19, 1937, at the age of 66, closed a life devoted to scientific research, in which the later years brought more than one man's share of disappointment and tragedy. At the age of 52, after having reached high academic rank in his own country and having attained wide recognition for his scientific research, he was forced to flee from his native land in peril of his life. He arrived practically penniless in the United States and started at the bottom to build a new career.

Dr. Sinitsin was born in Symferopol, Crimea, on February 23, 1871. He was graduated from the University of Warsaw in 1897 with the degree of Bachelor of Natural Sciences. The University of St. Petersburg conferred on him the degrees of Master of Zoology in 1905 and

Doctor of Zoology in 1911. From 1897–1906 he was curator of the Zoological Museum of the University of Warsaw and from 1906–1911 he was a privat-docent in the University of Moscow. He served as Professor in the Shanjavsky University from 1908 to 1917 and was professor and president of the Nijny-Novgorod University from 1918 to 1919. From 1920 to 1923, when he was forced to leave Russia, he served first in Symferopol University and then in the Minsk Agricultural Institute. After reaching the United States he finally obtained employment as a technician in the American Museum of Natural History in 1926. Here he was relieved of the usual duties of such a position and given the opportunity to carry on research. In 1928 he was appointed as Associate Zoologist in the Zoological Division of the Bureau of Animal Industry, U. S. Department of Agriculture at Washington, D. C. He resigned from this position in 1931 and moved to Los Angeles, California, where he was engaged in private research until the time of his death. His last years were saddened by the death of his wife under very tragic circumstances on the trip to California and by extreme poverty and ill health. Yet he continued actively at work on research almost up to the very end as is shown by the presence of his name as an author on one of the abstracts in the present number of the JOURNAL OF PARASITOLOGY.

Dr. Sinitsin's most important scientific work was on the life cycles of the digenetic trematodes. His monographs on the life cycles of the trematodes of fishes and frogs published in 1905 and on the larval trematodes of the snails from the Black Sea published in 1911 were important pieces of work, which foreshadowed the great developments in research in this field of the last two decades. His fundamental research on the life cycle and bionomics of the sheep liver fluke published on 1914 also attracted considerable attention. After moving to the United States he continued his researches on trematode life cycles and published a number of papers. His latest research interest, developed in his last years in California, was in the intestinal protozoa.

GERSHOM FRANKLIN WHITE (1873–1937)

The death of Dr. G. Franklin White on April 27, 1937, at Moorestown, New Jersey, removed a most capable and efficient research worker, a gentleman, and one of the best loved men in parasitology and related fields. Dr. White was born at Hooksburg, Ohio, December 22, 1873. He received his B.S. degree from Ohio University in 1901, and his Ph.D. degree from Cornell University in 1905. In 1909 he received an M.D. degree from George Washington University, and in 1918 he served in the United States Army as captain in the Medical Corps. From 1922 to 1926 he did some part-time graduate work in medical zoology at Johns Hopkins University.

While a graduate student at Cornell University Dr. White was an instructor in bacteriology and studied what was considered a bacterial disease of honey-bees. In this work he demonstrated and described causative organisms for two such diseases. In 1907 he was employed as insect pathologist in the Bureau of Entomology, where he carefully worked out and published monumental studies on the bacterial diseases, American and European Foulbrood, a filterable virus disease known as "Sacbrood," and a protozoan affection which he called "Nosema disease." These studies led to effective methods of disinfecting cones in bee hives for control of common diseases in apiaries. In recognition of this work Dr. White was made an honorary Fellow of a Royal Society in England.

Many of Dr. White's contributions to our knowledge of different diseases of insects were stimulated by young entomologists who experienced mortalities of insects in their field experiments. Some of them sought his advice because they wished to obtain breeding strains of insects free of diseases, some wished advice on procedures, technique, and in the evaluations of their studies, and others requested that he make a study of their disease problems. Such men always found in Dr. White a friendly interest, a sympathetic understanding, and a storehouse of information including articles in the current literature. His willingness to be of help and the eagerness of young workers to receive assistance caused Dr. White to be surrounded by a host of young friends and a variety of research problems. The different diseases of insects studied or described by him include a neosporidian infection of flour beetles, a protozoan and a bacterial disease of the Mediterranean flour moth; septicemiae of hornworms, cutworms, pink bollworms and Colorado potato beetles; causes of death among screwworm flies; polyhedral diseases of insects; and diseases of the immature stages of the Japanese beetle.

Among parasitologists Dr. White is perhaps best known for his studies on creeping eruption of man, which led to the discovery that this skin affection is caused by infective larvae of *Ancylostoma brazilliense* DeFaria. In the medical profession, and especially among those attending the meetings of the American Medical Association at Philadelphia in 1931, he will be remembered for the convincing demonstrations of his method of producing sterile fly larvae for use of surgeons in the Baer method of treating osteomyelitis. Students and younger workers in different branches of parasitology will remember his generosity and encouragement, his regard for his fellow workers, his modesty, his fine character, his delightful personality, and his true scientific spirit.—W. E. Dove.

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